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New records of *Graphis* from Cameroon, with a key to African species of *Graphis*

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Abstract—New records of *Graphis* species are reported from Cameroon, West Africa: *G. ajarekarii*, *G. alboglaucescens*, *G. brahmanensis*, *G. daintreensis*, *G. exalbata*, *G. gloriosensis*, *G. gonimica*, *G. handelii*, *G. immersella*, *G. novopalmicola*, *G. pseudoaquilonia*, and *G. supracola*. The material was collected in the tropical rain forests of Mount Cameroon. The diagnostic characters of the species are briefly discussed and illustrated. An artificial key is provided to facilitate identification of *Graphis* species known from the African Palaeotropics.

Key words—corticolous, crustose lichens, taxonomy, *Graphidaceae*, *Ostropales*

Introduction

Mount Cameroon (ca. 4°N 9°E) is the highest mountain (4095 m) in West Africa, being located near the Gulf of Guinea in the Southwest Region of Cameroon (Fonge et al. 2005, Proctor et al. 2007). The Mount Cameroon region has a diversity of complex ecosystems due to frequent disturbances, (especially volcanic activities) that have made it possible to study different successional stages in a relatively confined area (Focho et al. 2010). The western rain forests of Africa, despite having luxuriant forests with high organismic diversity, are little explored in terms of lichen diversity (including the *Graphidaceae*) compared to the Eastern Palaeotropics in Asia.

In the course of an ongoing research project, crustose lichens, particularly graphidoid representatives, were collected from rainforests at different

elevations at Mount Cameroon. The thelotremoid lichens in the *Graphidaceae* have been exhaustively studied in the region (Frisch et al. 2006); however, no detailed account on graphidoid taxa from this region is available and only scattered reports from the African Palaeotropics exist in the literature for this group (Müller 1890, Staiger 2002, Lücking et al. 2009).

Here we report twelve new species representing the genus *Graphis* Adans. collected in the Mount Cameroon area: *G. ajarekarii*, *G. alboglaucescens*, *G. brahmanensis*, *G. daintreensis*, *G. exalbata*, *G. gloriosensis*, *G. gonimica*, *G. handelii*, *G. immersella*, *G. novopalmicola*, *G. pseudoaquilonia*, and *G. supracola*. We also present an artificial key to the species of *Graphis* known from the African Palaeotropics.

Materials & methods

During January 2015 a field excursion organized by Prof. Andrew Enow Egbe, University of Buea, targeted one area in the Mount Cameroon region, Federal Republic of Cameroon. Lichen specimens are deposited in the lichen herbarium of the Korean Lichen Research Institute, Suncheon, South Korea (KoLRI), and duplicates are preserved in the Faculty of Science in the University of Buea, Cameroon. Samples were studied in CSIR-National Botanical Research Institute, Lucknow, India. The material was examined for morpho-anatomical and chemical features using a MSZ-TR dissecting microscope and a Leica DM 500 compound microscope. The protocol for color spot reaction tests and thin-layer chromatography (TLC) was derived from Orange et al. (2010). Thin-layer chromatography was performed in solvent systems A [toluene (180): 1, 4-dioxane (45): acetic acid (5)] and C [toluene (170): acetic acid (30)]. Lugol's solution (I) was used to check amyloidity of the ascospores. Illustrations were prepared using Corel Draw (vers. 12).

Taxonomy: new records

Graphis ajarekarii Patw. & C.R. Kulk., Norw. J. Bot. 26: 45, 1979. Pl. 1a

Thallus epiperidermal, slightly uneven, dull to ± glossy, ≤250 µm thick; prothallus dark brown; lirellae immersed to erumpent, strongly branched, 1–2 cm long, with a lateral to apically thin complete thalline margin; disc concealed; labia entire, epruinose; proper exciple laterally carbonized becoming completely carbonized in old lirellae, 50–70 µm thick; epihymenium brownish and granular, 15–20 µm high; hymenium hyaline, clear, 90–100 µm high; subhymenium 20–30 µm high; asci 8-spored, 100–130 × 20–25 µm; ascospores fusiform, transversely septate, 8–10-locular, amyloid, 28–48 × 8–11 µm.

Chemistry—Norstictic and stictic acids detected with TLC.

Distribution & ecology—Found growing in association with other graphidoid taxa on rough barked trees at higher altitudes.

Specimen examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°09′01″N 9°17′02″E, on bark, 25 February 2015, J–S. Hur CR150020 (KoLRI).

Remarks—*Graphis filiformis* Adaw. & Makhija, which otherwise resembles *G. ajarekarii* in producing norstictic acid and small ascospores, lacks stictic acid. *Graphis ajarekarii* was previously known from the Eastern Palaeotropics (Lücking et al. 2009).

Graphis alboglaucescens Adaw. & Makhija, Mycotaxon 99: 312, 2007. Pl. 1B

Thallus epiperidermal, ecorticate, farinose, greenish-white to glaucous green; lirellae immersed, elongate (1–2 cm long) and irregularly branched with lateral thalline margin; disc slightly exposed, white pruinose (*scripta*-morph); labia entire; proper exciple apically carbonized, 30–40 µm thick; epihymenium brownish, granular, 10–15 µm high; hymenium hyaline and clear, 90–100 µm high; subhymenium indistinct; asci 8-spored; ascospores fusiform, transversely septate, 5–10-locular, amyloid, 24–26 × 4–6 µm.

Chemistry—Norstictic acid detected with TLC.

Distribution & ecology—Found in small patches on hard and rough barked trees in evergreen forests at higher altitudes.

Specimen examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°07′26″N 9°11′17″E, alt. ca. 1200 m on bark, 26 February 2015, J–S. Hur CR150067 (KoLRI).

Remarks—In its anatomy, *G. alboglaucescens* resembles *G. glaucescens* Fée, which is distinguished by its lack of secondary metabolites and occasionally striate labia. *Graphis alboglaucescens* was originally described as producing lirellae covered up to the top by a thalline margin (Adawadkar & Makhija 2007), a character Lücking et al. (2009) later defined as a lateral thalline margin. The species exhibits a pantropical distribution (Lücking et al. 2009).

Graphis brahmanensis Aptroot, Lichenologist 41: 434, 2009. Pl. 1C

Thallus epiperidermal, thin, pale-brown, fawn to off-white, 80–100 µm, evanescent, indistinctly corticate reflecting bark; algal layer continuous, 28–30 µm thick; medulla mostly endoperidermal; lirellae prominent, 1–1.5 cm long, sparsely and irregularly branched with basal thalline margin (*striatula*-morph); labia striate (3–4-striations), epruinose; proper exciple laterally carbonized, 50–100 µm thick; epihymenium brownish, 10–15 µm high; hyaline and clear; hymenium 90–100 µm high; subhymenium 10–15 µm high; asci 8-spored; ascospores fusiform, transversely septate, 5–8-locular, amyloid, 25–30 × 6–8 µm.

Chemistry—Stictic acid detected with TLC.

Distribution & ecology—Found growing in association with other corticolous lichen taxa at low altitudes on smooth barked trees of tropical rain forests.

Specimen examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°05′41″N 9°22′24″E, alt. ca. 100 m, on bark, 26 February 2015, J–S. Hur CR150072 (KoLRI).

Remarks—In most characters, *G. brahmanensis* resembles *G. vittata* Müll. Arg., which differs in producing lirellae with a lateral thalline margin. The otherwise similar *G. duplicata* Ach. lacks secondary compounds.

Graphis brahmanensis was previously known from the Neotropics, (particularly in the southeastern USA) and Eastern Palaeotropics (Lücking et al. 2009).

Graphis daintreensis (A.W. Archer) A.W. Archer, Telopea 11: 72, 2005. Pl. 1d

Thallus epiperidermal, silver-gray to greenish gray or whitish-gray, off-white, glossy, uneven, 200–250 µm thick, corticate; cortex continuous, 20–30 µm thick; algal layer 40–140 µm thick, embedded with large and small crystals; indistinct to endoperidermal medulla; indistinct to off white prothallus; lirellae elongate (1–2 cm long), densely and irregularly branched, prominent with basal thalline margin (*hossei*-morph); disc concealed; labia entire and epruinose; proper exciple laterally carbonized, 40–60 µm thick; epihymenium brownish, crystalline, 15–20 µm high; hymenium hyaline and clear, 130–150 µm high; subhymenium indistinct; asci broadly clavate, 1-spored, 110–120 × 25–30 µm; ascospores muriform, multi-celled, amyloid, 60–90 × 20–25 µm.

Chemistry—No chemicals detected with TLC.

Distribution & ecology—In Cameroon, this taxon was collected from the rainforests at very low altitudes, and was found growing in large patches on rough barked trees.

Specimen examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°04′09″N 9°22′36″E, alt. ca. 30 m, on bark, 26 February 2015, J–S. Hur CR150081 (KoLRI).

Remarks—*Graphis nanodes* Vain., which resembles *G. daintreensis* in most taxonomic characters, differs in its lirellae with lateral thalline margins (*lineola*-morph) and smaller ascospores (≤50 µm long).

Graphis daintreensis was previously known only from the Eastern Palaeotropics (Lücking et al. 2009).

Graphis exalbata Nyl., Lich. Ins. Guin.: 28, 1889. Pl. 1e

Thallus epiperidermal, whitish, smooth to slightly uneven, glossy, indistinctly verruculose, continuous, ecorticate, 100–200 µm, and embedded with crystals;

algal layer ≤90 µm thick, embedded with crystals; medulla endoperidermal; prothallus indistinctly whitish; lirellae ± immersed to erumpent, elongate (1–2 cm long), radially branched with lateral thalline margin; disc concealed; labia indistinctly striate, white pruinose (*glaucescens*-morph); proper exciple apically carbonized, 30–60 µm thick; epihymenium grayish crystalline, 5–10 µm high; hymenium hyaline and clear, 90–100 µm high; subhymenium 15–20 µm high; asci 8-spored, 90–100 × 10–15 µm; ascospores transversely septate, 8–10-locular, amyloid, 30–38 × 8–9 µm.

Chemistry—Norstictic acid detected with TLC.

Distribution & ecology—Found growing in large patches on thin and smooth barked trees in evergreen forests.

Specimen examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°09′01″N 9°17′02″E, on bark, 25 February 2015, J–S. Hur CR150024 (KoLRI).

Remarks—*Graphis eburnea* Adaw. & Makhija, which is morphologically and chemically close to *G. exalbata,* is distinguished by its epruinose labia (*nigrosina*-morph).

Lücking et al. (2009) previously reported *G. exalbata* from the Palaeotropics.

Graphis gloriosensis A.W. Archer & Elix, Telopea 11: 454, 2007 Pl. 1f

Thallus epiperidermal, thin, pale-brown, fawn to off-white, indistinctly corticate 50–100 µm thick, reflecting bark; algal layer continuous, 28–30 µm thick; medulla mostly endoperidermal; lirellae prominent, sparsely and irregularly branched, 1–1.5 cm long with lateral thalline margin (*marginata*-morph); labia entire, epruinose; proper exciple completely carbonized, 50–100 µm thick; epihymenium brown, granular,10–15 µm high; hymenium hyaline and densely inspersed (with oil droplets), 90–100 µm high; subhymenium 10–15 µm high; asci 8-spored; ascospores fusiform, transversely septate, 10–15-locular, amyloid, 40–70 × 10–15 µm.

Chemistry—Stictic and hypostictic acids detected with TLC.

Distribution & ecology—Collected from tree bark in evergreen forests at higher altitudes.

Specimen examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°07′40″N 9°11′54″E, alt. 1150 m, on bark, 26 February 2015, J–S. Hur CR150060 (KoLRI).

Remarks—In thallus color and texture and in chemistry *G. gloriosensis* superficially resembles *G. brahmanensis*, which differs in its striate labia, laterally carbonized proper exciple, and clear hymenium.

Lücking et al. (2009) reported *G. gloriosensis* from the Eastern Paleotropics.

Graphis gonimica Zahlbr., Ann. Mycol. 30: 431, 1932. Pl. 1G

Thallus epiperidermal, whitish-gray, silver-gray, white or dark-gray, glossy, ≤200 µm thick; cortex 30–40 µm thick, continuous; algal layer 45–60 µm thick; medulla white, crystalline, 60–100 µm thick; prothallus dark brown; lirellae immersed, short (0.5–1 cm long) and scarcely furcated with lateral thalline margin (*lineola*- or *deserpens*-morph); disc concealed; labia entire and epruinose; proper exciple ± completely carbonized, 60–150 µm thick; epihymenium brownish, granular, 10–15 µm high; hymenium densely inspersed (with oil droplets), 140–160 µm high; subhymenium indistinct; asci 8-spored; ascospores fusiform, transversely septate, 6–12-locular, amyloid, 30–50 × 7–9 µm.

Chemistry—Norstictic acid detected with TLC.

Distribution & ecology—Found growing in small patches associated with *Glyphis cicatricosa* Ach. and *Arthonia* sp. on uneven and thick barked trees in evergreen forests.

Specimen examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°09′01″N 9°17′02″E, on bark, 25 February 2015, J–S. Hur CR150035, CR150036 (KoLRI).

Remarks—The morphologically similar *G. cincta* (Pers.) Aptroot differs in its laterally carbonized proper exciple.

Lücking et al. (2009) previously reported *G. gonimica* from the Paleotropics.

Part of our material sometimes produces stictic acid and atranorin (in traces) as additional compounds, but we refrain from proposing a taxon new to science until further collection and evaluation.

Graphis handelii Zahlbr., Symb. Sinic. 3: 44, 1930. Pl. 1H

Thallus epiperidermal, off-white, grayish-green to gray, 100–150 µm thick; cortex continuous, 20–30 µm thick; algal layer continuous, 30–40 µm thick; medulla white crystalline, epi- to endoperidermal, 50–80 µm thick; lirellae erumpent to prominent, short (≤5 mm long), simple to furcate; disc exposed and epruinose, brown; labia entire and epruinose; proper exciple laterally carbonized 20–50 µm thick; epihymenium brownish, 10–15 µm high; hymenium hyaline and inspersed (with oil droplets), 90–100 µm high; subhymenium 20–30 µm high; asci 8-spored, 70–90 × 10–15 µm; ascospores fusiform, transversely septate, 5–9-locular, amyloid, 28–32 × 5–7 µm.

Chemistry—Norstictic acid detected with TLC.

Distribution & ecology—Collected from smooth barked trees in evergreen forests.

Specimens examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°09′01″N 9°17′02″E, on bark, 25 February 2015, J–S. Hur CR150028, CR150038 (KoLRI).

Remarks—*Graphis crebra* Vain. is similar but is distinguished by its white-pruinose disc.

Lücking et al. (2009) report a pantropical distribution for *G. handelii*.

Graphis immersella Müll. Arg., Bull. Herb. Boissier 3: 319, 1895. Pl. 1I

Thallus epiperidermal, off white, greenish-gray, ≤150 µm thick; cortex continuous, 30–50 µm thick; algal layer 30–40 µm thick; medulla endoperidermal; prothallus blackish; lirellae erumpent, short (≤1 cm long) and sparsely branched (*lineola*-morph) with lateral thalline margin; disc concealed; labia entire and epruinose; exciple laterally carbonized, 20–60 µm thick proper; epihymenium dark brown, crystalline, 10–15 µm high; hymenium hyaline and clear, 100–150 µm high; subhymenium indistinct; asci broadly clavate, 8-spored, 90–100 × 10–15 µm; ascospores transversely septate, 8–11-locular, amyloid, 35–55 × 8–10 µm.

Chemistry—Stictic acid detected with TLC.

Distribution & ecology—Collected from rather smooth barked trees in evergreen forests.

Specimen examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°07′41″N 9°12′20″E, on bark, 26 February 2015, J–S. Hur CR150057 (KoLRI).

Remarks—*Graphis pinicola* Zahlbr. is morphologically similar to *G. immersella* but lacks lichen compounds.

Lücking et al. (2009) report a palaeotropical distribution for *G. immersella*.

Graphis novopalmicola A.W. Archer & Lücking, Lichenologist 41: 439, 2009. Pl. 1J

Thallus epiperidermal, pale-gray to yellowish-gray, dull, loosely corticate, 150–200 µm thick, continuous in large patches; cortex 20–30 µm thick embedded with crystals; algal layer continuous, 40–50 µm thick; medulla mostly endoperidermal and crystalline, 100–150 µm thick; prothallus whitish; lirellae erumpent to prominent, simple to furcate, short to elongate (1–1.5 cm long) with a thick lateral thalline margin (*subserpentina*-morph); concealed disc; entire and epruinose labia; proper exciple completely carbonized, ≤50 µm thick; epihymenium brownish crystalline, 10–15 µm high; hymenium densely inspersed (with oil droplets) 150–170 µm high; subhymenium indistinct to 20 µm high; asci broadly clavate, 1-spored; ascospores large, muriform, multi-celled, amyloid, 90–110 × 20–30 µm.

Chemistry—Norstictic acid detected with TLC.

Distribution & ecology—Collected from smooth barked trees in evergreen forests near foothills.

Specimens examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°04′09″N 9°22′36″E, alt. ca. 30 m, on bark, 26 February 2015, J–S. Hur CR150079, CR150080 (KoLRI).

Remarks—*Graphis leprographa* Nyl., which resembles *G. novopalmicola* in having 1–2-spored asci and similar chemistry, differs in its very short and unbranched lirellae (*dussii*-morph).

Lücking et al. (2009) report a pantropical distribution for *G. novopalmicola.*

Graphis pseudoaquilonia Lücking, Lichenologist 44: 393, 2012. Pl. 1k

Thallus epiperidermal, cartilaginous, grayish-green, dark-gray to gray, continuous, glossy, corticate, spreading in large wide patches; lirellae prominent, elongate (1–2 cm long), sinuous, irregularly branched with complete thalline margin; disc concealed; labia striate (*archeri*-morph); proper exciple completely carbonized, 90–100 µm thick; epihymenium brownish, granular, 10–15 µm high; hymenium hyaline and clear, 100–150 µm high; subhymenium 20–30 µm high; asci 2–6-spored; ascospores fusiform, terminally muriform, amyloid [(10–15-septate in the middle × 1–2 longitudinal septa per cell in the terminal segments)], 50–80 × 9–15 µm.

Chemistry—Norstictic acid detected with TLC.

Distribution & ecology—Found growing in large patches on uneven and thick barked trees in evergreen forests.

Specimens examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°09′01″N 9°17′02″E, on bark, 25 February 2015, J–S. Hur CR150011, CR150025 (KoLRI).

Remarks—*Graphis norvestitoides* Sutjaritt., which is otherwise similar to *G. pseudoaquilonia* in all characters, is distinguished by its strongly inspersed hymenium (Lücking et al. 2012).

Graphis pseudoaquilonia has previously been reported from the Neotropics and Eastern Palaeotropics (Lücking et al. 2009, Lücking et al. 2012).

Graphis supracola A.W. Archer, Aust. Syst. Bot. 14(2): 267, 2001. Pl. 1l

Thallus whitish-gray to gray, greenish-gray, loosely corticate, ≤100 µm thick, smooth to slightly verruculose, spread in patches; cortex discontinuous ≤15 µm thick, overlying a discontinuous layer of crystals; algal layer 40–60 µm thick; medulla mostly endoperidermal; prothallus dark brown; lirellae immersed, simple to furcate, 1–2 cm long with lateral thalline margin; disc concealed to sometimes slightly open; labia entire and white pruinose (*caesiella*-morph);

proper exciple laterally carbonized, 30–50 µm thick; epihymenium brownish, 5–10 µm high; hymenium hyaline and clear, 50–100 µm high; subhymenium 35–45 µm high; asci 8-spored; ascospores fusiform, transversely septate, 6–10-locular, amyloid, 25–32 × 7–10 µm.

Chemistry—Protocetraric acid detected with TLC.

Distribution & ecology—Found growing on tree barks in evergreen forests at low altitudes.

Specimens examined: **CAMEROON. Southwest province:** Mount Cameroon, 4°09′01″N 9°17′02″E, on bark, 25 February 2015, J–S. Hur CR150023 (KoLRI); 4°05′41″N 9°22′24″E, alt. ca. 100 m, on bark, 26 February 2015, J–S. Hur 150069 (KoLRI).

Remarks—This taxon can be confused with *Graphis distincta* Makhija & Adaw., which differs in additionally producing stictic and constictic acids.

Lücking et al. (2009) report a pantropical distribution for *G. supracola*.

Key to *Graphis* species recorded from the African Palaeotropics

Taxonomic key characters of *Graphis* species not included in our collections derived primarily from Lücking et al. (2009) and Broeck et al. (2014)

1. Lirellae orange-pigmented, prominent to sessile, short to elongate, sparsely to irregularly branched; ascospores terminally muriform, 70–120 × 10–15 µm; no lichen substances present ..... ***G. subchrysocarpa***
1. Lirellae not pigmented 2
2. Labia entire; hymenium clear or inspersed 3
2. Labia striate; hymenium clear 32
3. Proper exciple completely carbonized 4
3. Proper exciple apically to laterally carbonized 16
4. Hymenium inspersed 5
4. Hymenium clear 8
5. Ascospores muriform, 90–110 × 20–30 µm; norstictic acid present ..... ***G. novopalmicola***
5. Ascospores transversely septate 6
6. Lichen substances absent; lirellae erumpent with complete thalline margin (*subserpentina*-morph); ascospores 18–20-locular, 100–120 × 14–18µm ..... ***G. superans***
6. Lichen substances present 7
7. Stictic acid present; ascospores 10–15-locular, 50–90 × 10–15 µm .... ***G. gloriosensis***
7. Norstictic acid present; ascospores 6–12-locular, 30–50 × 7–9 µm ..... ***G. gonimica***
8. Lichen substances present 9
8. Lichen substances absent 11

9. Constictic and stictic acids present; lirellae prominent, ± simple with lateral to almost complete thalline margins; ascospores muriform, 60–110 µm long ..... ***G. vandenboomiana***

9. Stictic acid present; ascospores transversely septate 10

10. Lirellae with apically thick complete thalline margin (*subserpentina*-morph); ascospores 70–90 µm long ..... ***G. schroederi***

10. Lirellae with thick lateral thalline margin (*marginata*-morph); ascospores 45–120 µm long ..... ***G. rustica***

11. Ascospores muriform, 20–30 µm long; lirellae erumpent, short to sparsely branched with basal thalline margin (*subregularis*-morph) ..... ***G. comma***

11. Ascospores transversely septate, ≤50 µm long 12

12. Lirellae with complete thalline margin 13

12. Lirellae with basal to lateral thalline margin 15

13. Unknown lichen substances present; ascospores 3-septate, 11–17 µm long ..... ***G. aptrootiana***

13. No lichen substances present; ascospores 3- or more septate 14

14. Lirellae short and sparsely branched (*negrosina*-morph) ..... ***G. negrosina***

14. Lirellae elongate, irregularly branched (*farinulenta*-morph) ..... ***G. sitiana***

15. Lirellae short, stellate with basal thalline margin (*geraensis*-morph) ***G. dracaenae***

15. Lirellae elongate, irregularly branched with thick lateral thalline margin (*marginata*-morph) ..... ***.G. oxyclada***

16. Proper exciple apically carbonized; hymenium clear 17

16. Proper exciple laterally carbonized; hymenium clear or inspersed 18

17. Lirellae immersed to erumpent, short, sparsely or stellately branched (*lineola*- or *coarctata*-morph); ascospores muriform, 25–45 × 13–20 µm; lichen substances absent ..... ***G. pergracilis***

17. Lirellae immersed, ascospores transversely septate, 24–26 × 4–6 µm; norstictic acid present ..... ***G. alboglaucescens***

18. Hymenium inspersed 19

18. Hymenium clear 22

19. Ascospores muriform 20

19. Ascospores transversely septate 21

20. Norstictic acid present; lirellae immersed to erumpent, elongate & irregularly branched with thick lateral to complete thalline margin (*subserpentina*-morph); ascospores 50–110 × 15–30 µm ..... ***G. insulana***

20. Lichen substances absent; lirellae erumpent, short to elongate, sparsely to irregularly branched with lateral thalline margin (*lineola*- or *deserpens*-morph); ascospores 35–50 × 8–15 µm ..... ***G. subvelata***

Plate 1. *Graphis* species from Cameroon. A. *G. ajarekarii*; B. *G. alboglaucescens*; C. *G. brahmanensis*; D. *G. daintreensis*; E. *G. exalbata*; F. *G. gloriosensis*; G. *G. gonimica*; H. *G. handelii*; I. *G. immersella*; J. *G. novopalmicola*; K. *G. pseudoaquilonia*; L. *G. supracola*. Scales: A, B, D, F, G, J, L = 10 mm, C, E, H, I, K = 0.5 mm.

21. Disc exposed, epruinose (*handelii*-morph); norstictic acid present; ascospores 5–9-locular, 28–32 × 5–7 µm ..... ***G. handelii***

21. Disc concealed, labia epruinose (*lineola*-morph); no lichen substances; ascospores 6–10-locular, 20–40 × 6–9 µm ..... ***G. lineola***

22. Ascospores muriform 23

22. Ascospores transversely septate 25

23. Norstictic acid present; lirellae erumpent, elongate & irregularly branched with lateral thalline margin (*deserpens*-morph); ascospores 20–35 × 8–14 µm ..... ***G. renschiana***

23. Lichen substances absent; ascospores more than 50 µm long 24

24. Lirellae prominent with basal thalline margin (*hossei*-morph) ..... ***G. daintreensis***
24. Lirellae erumpent with lateral to apically thick complete thalline margin (*subserpentina*-morph) ..... ***G. subhiascens***

25. Lichen substances absent; ascospores ≤45 µm long 26
25. Lichen substances present; ascospores ≤60 µm long 27

26. Thallus partly ecorticate; lirellae thin, flexuous with gently sloping in thalline margin; labia white pruinose (*caesiella*-morph) ..... ***G. furcata***
26. Thallus corticate; lirellae thick; straight or curved with abruptly sloping thalline margin; labia epruinose (*lineola*- or *deserpens*-morph) ..... ***G. pinicola***

27. Norstictic or stictic or protocetraric acids present 28
27. Stictic acid additionally with atranorin or norstictic acid present 31

28. Norstictic acid present 29
28. Norstictic acid absent 30

29. Lirellae erumpent, ascospores ≤45 µm long ..... ***G. librata***
29. Lirellae immersed to erumpent, short & sparsely branched (*lineola*-morph); ascospores 45–60 µm long ..... ***G. erythrocardia***

30. Stictic acid present; labia epruinose (*lineola*-morph) ..... ***G. immersella***
30. Protocetraric acid present; labia white pruinose (*caesiella*-morph) ... ***G. supracola***

31. Stictic acid & traces of atranorin present; ascospores 4-locular, 12–17 µm long ..... ***G. tetralocularis***
31. Stictic acid & norstictic acid present; ascospores 8–10-locular, 35–55 µm long ..... ***G. ajarekarii***

32. Proper exciple completely carbonized 33
32. Proper exciple apically to laterally carbonized; ascospores transversely septate .. 34

33. Ascospores muriform, 30–65 × 10–15 µm; lirellae erumpent, elongate & irregularly branched with lateral thalline margin; disc concealed; labia epruinose (*tenella*-morph); no lichen substances present ..... ***G. plurispora***
33. Ascospores terminally muriform, 50–80 × 9–15 µm; norstictic acid present ..... ***G. pseudoaquilonia***

34. Proper exciple apically carbonized 35
34. Proper exciple laterally carbonized 36

35. Norstictic acid present; ascospores 30–38 µm long ..... ***G. exalbata***
35. Lichen substances absent; ascospores 25–35 µm long ..... ***G. glaucescens***

36. Stictic acid present; ascospores 5–8-locular, 25–30 × 6–8 µm .... ***G. brahmanensis***
36. Lichen substances absent 37

37. Lirellae erumpent, short & sparsely branched with lateral thalline margin (*tenella*-morph); ascospores 15–45 × 6–9 µm ..... ***G. tenella***
37. Lirellae prominent, elongate & irregularly branched, lacking or with basal thalline margin (*striatula*-morph); ascospores 30–65 µm × 7–12 µm ..... ***G. striatula***

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